Strategic Value Creation through Enterprise Blockchain

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Abstract

Blockchain and other distributed ledger technologies have enormous potential for creating business value but have not yet been widely adopted. Enterprise blockchain systems are recognised as solutions to existing operational problems or 'pain points' but their potential for delivering value through strategic opportunities is not well understood. Drawing from literature on strategic alliances and the resource-based view of the firm, we identify avenues through which blockchain systems can contribute to a firm's strategic capabilities and, as a result, to its sustained competitive advantage. We provide a framework for understanding how participation in blockchain solutions can enable companies to build upon existing strategic capabilities, strengthen collaborative capabilities and develop blockchain-specific capabilities. The framework can be useful to firms and service providers for incorporating strategic outcomes into the evaluation of blockchain investment opportunities.

1. Introduction

Blockchain and other distributed ledger technologies provide databases or ledgers that are shared among multiple parties. Transactions stored in these ledgers are validated, timestamped and secured. Once recorded, they cannot be changed or deleted. Shared ledgers can improve data transparency, efficiency and collaboration among participants. While initially created for the transfer of cryptocurrency, blockchain use has increased exponentially since its introduction [1]. Enterprise blockchains have emerged as the means through which multiple partners that are known to each other collaborate in storing records and conducting transactions using a shared ledger. These partners agree to certain rules, such as who has visibility into each record. These shared rules provide benefits such as helping facilitate the management and sharing of sensitive information such as customer and financial data, without breaching privacy laws [2].

Despite blockchain's potential for strategic impact, its adoption has not lived up to what some refer to as its hype [3]. Research on 517 blockchain projects finds that many projects fail to address clearly defined and significant problems and lack evidence to support the use of blockchain solutions [4]. In this article, we examine an important factor that may contribute to the incomplete evidence supporting blockchain use. In general, blockchain has been viewed as a solution for improved operational outcomes [5] rather than a potential source of strategic value. While the operational benefits of blockchain are

becoming more widely recognised, blockchain's potential to support strategic capabilities and competitive plans is not well understood. We address this gap by providing a framework that can be used to systematically evaluate strategic outcomes of blockchain projects.

We begin by describing foundational elements of enterprise blockchains. We discuss the processes currently used to assess blockchain, processes which focus on operational improvements and overlook strategic benefits. We then introduce constructs from the academic literature on strategic alliances and the resource-based view (RBV) of the firm that are relevant for the enterprise blockchain context and provide the basis for understanding the strategic opportunities presented by these systems. Finally, we present a framework and examples that identify and categorise ways companies can build strategic capabilities through participation in blockchain consortia.

2. Key Elements of Enterprise Blockchains

The term blockchain refers to a specific type of distributed ledger system in which transactions are stored in blocks analogous to tabs in a spreadsheet arranged in a temporal sequence [6]. Although many no longer use blocks to store data, distributed ledger systems are commonly referred to as blockchains, a term that will be used throughout this paper.

Blockchains can be "permissioned" or "permissionless". Permissionless blockchain systems such as the Bitcoin blockchain are open to all users. Without obtaining permission, anyone can establish an identity and execute transactions over the platform, and anyone can participate in maintaining the network by downloading the software used to validate and store transactions. Bitcoin and Ethereum are the most well-known examples of permissionless blockchains.

Blockchains used by enterprises are typically permissioned. These blockchains are developed and maintained by a known group of participants who have established their identities and have agreed to abide by the rules that govern the blockchain. Governance agreements determine the rights and responsibilities of each blockchain participant. Data stored on the chain are associated with the identities of the participants who attested to its validity. Data are typically encrypted and visible only to those participants or parties to which access has been granted, such as supply chain partners, auditors, or regulators.

Core elements of interest in an enterprise blockchain are distributed ledgers, digital assets, and smart contracts. Distributed ledgers are used to store transactions that are executed by blockchain participants, such as information about the transfer of goods from one party to another. These transactions can be written to the blockchain by transacting parties or by Internet of Things (IoT) devices such as Radio-Frequency Identification (RFID) chips. Ledgers can be used to store basic transactions, as in a traditional database, and they can also store digital assets and smart contracts.

Digital assets such as cryptocurrency, software or music, can be secured and ownership can be validated on a blockchain. "Digital twins" that provide digital representations of physical assets, such as deeds, titles, patents or ownership shares can also be stored and transferred using a blockchain system. Blockchains provide the ability to ensure that only one copy of a digital asset, such as a bitcoin or car title, is valid, so that if it is sent to another party, the sender's copy is no longer valid. This enables assets of value to be securely transferred between blockchain participants without the need for banks or other trusted brokers.

Smart contracts, which are programs containing if-then logic, can be stored on the blockchain and executed automatically as predefined conditions are met. For example, a shipping contract can be programmed so that when a set of RFID chips cross to a loading dock, a receiving report is generated and digitally signed, authorising a digital payment.

Blockchain's unique features provide several benefits in an enterprise context. Every piece of information stored in a blockchain is linked to the identities of the parties that initiated and validated the data, which establishes legitimacy and origin. This provides accountability and ensures that information can be traced to a validated source. Entries in a ledger are timestamped and immutable, which establishes an audit trail and provides transparency into the provenance of assets.

3. Identification and Evaluation of Blockchain Solutions

When an enterprise explores potential benefits of blockchain solutions, the objective is typically to achieve operational improvements such as cost avoidance, risk reduction, and improved customer experience. The exploration process involves identification of potential use cases—specific uses for blockchain systems that can produce these operational benefits. This is a technology-driven process in which corporate use cases are matched with technological capabilities to determine whether blockchain is a fit.

Like information technology (IT) projects that follow an analysis-design-implementation approach, analysis of potential blockchain use cases generally begins with problem identification. Guidance provided to companies usually centres around solving current and known problems, often referred to as pain points or frictions. McKinsey [7], for example, asserts that "Organizations must start with a problem. Unless there is a valid problem or pain point, blockchain likely won't be a practical solution." The World Economic Forum [8] states, "Good use cases must solve real problems for organizations. Great use cases solve real problems at a cost that is significantly lower than the benefits the adoption brings." PwC advises firms considering embarking on a blockchain to begin by assessing what the firm is trying to accomplish, which "starts with pain points that are tested against key criteria, to determine if blockchain is a good fit or if other technologies are better placed." [9] IBM, which has been ranked as the leading service provider in the blockchain space [10], guides companies considering blockchain solutions to focus on current problems and why and for whom they are problems. At the ecosystem level IBM suggests focusing on friction, which "at the industry level, provides a Founders Handbook for evaluating enterprise blockchain solutions. The Handbook begins by focusing on problems with three essential questions for identifying potential use cases: "1. What's the problem with the way we do things today? 2. Who is this a problem for? 3. Why is this a problem?" [11].

IBM's approach extends the analysis to examine problems in the interactions between companies. In a white paper [12], IBM states "Blockchain technology…has the potential to obviate intractable inhibitors across industries." The paper further argues that as frictions are reduced, enterprises and entire industries will be restructured. While these goals are expansive, IBM focuses on known operational problems. IBM's Founders Handbook [11] also suggests focusing on friction, "Based on your professional experience within your industry, identify a specific process currently creating friction among multiple parties in the same ecosystem. We recommend focusing on a use case with the greatest amount of friction." Klein et al. [13], who provide a use-case identification framework based on extensive research, also base their recommendations on the current state of the ecosystem. They argue that "Blockchain technology offers great potential for cost, time and efficiency improvements of existing business models."

Traditional use-case analyses prioritise blockchain solutions to operational problems and emphasise well-understood benefits associated with these solutions. Blockchains are effective in addressing the lack of trust between trading partners by providing the ability to track the provenance of transactions and digital assets and ensuring the immutability of records. They can also reduce friction in inter-company workflows through the use of smart contracts and automated value-transfer mechanisms which can reduce costs directly or through disintermediation.

Current approaches have made strides in exploring and addressing existing operational problems, The Centre for Evidence-Based Blockchain advances this project by providing a comprehensive framework for evaluating whether the outcomes of a blockchain intervention are superior to existing solutions for solving important problems [4]. Despite the increasing sophistication in identifying beneficial use cases, there are currently no frameworks that provide guidance for envisioning or evaluating the strategic opportunities and innovations that blockchains could enable. As a result, the cost of implementing a new and unfamiliar blockchain solution is weighed against operational returns such as reduced costs and operational efficiencies but not against strategic benefits.

Some blockchain proponents have begun to recognise that blockchain can support certain strategic goals. McKinsey [7], for example, notes that "Blockchain appeals to industries that are strategically oriented toward modernization. These see blockchain as a tool to support their ambitions to pursue digitization, process simplification, and collaboration", and points to the reputational value of being an innovator. Others have pointed to the role of blockchain in reinventing processes and products [14].

In the right circumstances, the capabilities addressed by McKinsey and Accenture could contribute to an enterprise's competitive advantage. The strategic potential of blockchain solutions extends far beyond these examples, however, and a more complete analysis could uncover new possibilities.

4. Strategic Alliances and Competitive Advantage

To unpack how participation in an enterprise blockchain can create strategic value for a firm, we draw upon the academic literature on strategic alliances through the lens of RBV. RBV [15] presents a view of firms as collections of resources. According to RBV, to the extent that the resource endowments of a firm are Valuable, Rare, Inimitable, and Organisational to be accessible – these resources form the basis of the firm's sustainable competitive advantage. For this paper, it is sufficient to identify RBV as a perspective that can help firms identify what resources they have, or need to access, to be successful. RBV, however, does not provide guidance on how a firm is to go about accessing those resources. Looking at strategic alliances as a means to access resources provides the linkage to blockchain consortia – blockchain consortia are a type of strategic alliance. A strategic alliance is a voluntary arrangement among firms that exchange or share resources, or collaborate in the development of products, services or technologies [16]. Alliances can also be cooperative arrangements between two or more firms to improve

their competitive position and performance by sharing resources [17], [18, [19]. The RBV perspective portrays firms as collections of heterogeneous resources [20], [21], [22]. Resources that can be sources of competitive advantage are rare, valuable and are difficult to imitate or substitute [21]. Within this perspective, there has been an increasing focus on dynamic capabilities, as bundles of resources that over time can lead to competitive advantage [23], [24]. Capabilities are a special type of intangible resources, they are organizationally embedded, non-transferable, and firm-specific resources whose purpose is to improve the productivity of the other resources possessed by the firm [25]. They may include company expertise in quality, product or service, innovation, customer service or price leadership [26]. For example, Apple Inc. is seen as having strategic capabilities in their design methodology, systems integration and their understanding of consumer behaviour; Tesla is seen as having superior engineering expertise in battery-powered motors and power trains [27].

The research on strategic alliances using an RBV lens has focused on how alliances reinforce and build capabilities that can uncover sources of competitive advantage [28]. There are different avenues through which alliances can create competitive advantage [29]. One avenue is when the alliance builds on an existing capability. For example, if a firm's competitive advantage centres on customer service, an alliance that builds on this capability can facilitate the firm's competitive advantage. Another avenue is when there are complementary capabilities among the partners. If one firm has expertise in R&D and another firm in marketing and distribution, for example, a strategic alliance can build on each firm's capabilities and give either, or both, an advantage in their respective marketplaces. A third avenue is when new capabilities are created because of the alliance. For example, when partners can enter a new market, each has the potential to build capabilities in new markets. This was common when traditional brick and mortar businesses entered online sales through alliances. Once the alliance was established, the brick and mortar businesses were able to develop their own capabilities around online selling.

Blockchain consortia can be understood as forms of strategic alliances, with the same potential for improving competitive advantage for alliance partners. Our framework illustrates how participation in blockchain consortia can lead to competitive advantage through these three avenues.

5. Blockchain-Based Strategic Capabilities Framework

Enterprise blockchain solutions can provide the basis for strengthening and building a range of capabilities that contribute to long-term competitive advantage. As enterprises evaluate blockchain opportunities they should look beyond operational benefits to determine whether and how participation can affect firm strategy. In Table 1, we present a framework that identifies several ways blockchain solutions can enhance strategic capabilities. Blockchain participants can: 1) strengthen and leverage their existing capabilities; 2) share and build complementary capabilities and 3) build blockchain-specific capabilities.

Table 1: Blockchain-Based Strategic Capabilities Framework

Build upon existing capabilities – Consortium participants can strengthen their existing capabilities.		
VALUE	**CAPABILITY**	**EXAMPLE**
Value proposition	Participants can strengthen their capability to verify claims made in their value proposition	Everledger gives diamond producers the ability to trace a diamond's true provenance and certify its value, increasing customer trust in the diamond's quality and origin in a conflict-free zone.
Network reach	Participants can expand their network of trading partners with verifiable information	REX Homes is a blockchain-based multiple listing service for commercial real estate. Real estate owners can provide trustworthy inspection, maintenance and utility records. Buyers can provide validated identity and financial data, increasing transaction efficiency.
Access to markets	Participants can gain access to new markets and customers	Municipal Transport Company of Madrid (EMT) allows transit passengers to use a single app to access all of the city's mobility services. As a result, partners gain access to new customers who had not previously booked with them.

Share complementary capabilities – Consortium participants can enhance capabilities through sharing complementary resources with partners.		
VALUE	**CAPABILITY**	**EXAMPLE**
Access to resources	Participants can leverage partners' resources	Consortium partners of The Port of Rotterdam allow the port to monitor the movement of goods. The Port can dynamically allocate resources such as slips, cranes and personnel to improve efficiency for transportation partners and enhance its own logistics advantage.
Access to data	Participants can gain access to new data housed on distributed ledgers shared by partners	The Insurwave marine insurance project allows Maersk, an intercontinental shipper, to purchase tailored insurance products based on real-time weather and route data gathered by Maersk's vessels and shared with insurers.
Shared risk	Participants can hedge against uncertainty through effective use of blockchain resources	MediLedger provides a track and trace system that enables pharmaceutical companies to enhance the security of opioids and other pharmaceuticals, to reduce counterfeits and enhance patient safety. This increases regulatory compliance and reduces risk for participants.
Strengthened relationships	Participants build relational capital that supports non-blockchain collaboration	The Pistoia Alliance collaborated on a multi-pharma partnership for decentralized identity management. Later, partners sponsored blockchain hackathons for potential joint investment opportunities.

Build blockchain-specific capabilities – Consortium participants can build new capabilities related to blockchain participation.		
VALUE	**CAPABILITY**	**EXAMPLE**
Smart contract expertise	Participants can gain expertise in using contracts to manage idiosyncratic business processes and agreements	GrainChain uses smart contracts to manage transactions between grain purchasers and farmers. The contracts escrow ownership and payments, with payments determined by complex calculations based on the weight of the shipment, moisture, chemical composition, timing and other variables.
Consortium and use case expertise	Participants can gain experience and resources that enable them to identify strategic use cases and join or found consortia	Henkel has experimented with numerous blockchain pilots and implementations. The company has developed deep consortium-related expertise and now participates in a diverse portfolio of blockchain projects.
New relationships and collaborations	Participants can develop relationships with consortium partners that enable subsequent blockchain collaborations	PharmaLedger's consortium members have been developing and testing blockchain use cases. Through their work on early projects, the consortium has established ethical and legal frameworks that now support eight use cases.

The Blockchain-Based Strategic Capabilities Framework illustrates a wide range of strategic capabilities that can potentially be affected by blockchain solutions. Companies exploring blockchain solutions can use this framework as they evaluate whether these solutions offer opportunities for building and improving strategic capabilities.

A. Strengthen and Leverage Existing Capabilities

Some firms use blockchain to strengthen existing capabilities. They accomplish this through 1) building on existing value propositions; 2) extending networks; and 3) gaining access to new markets.

*1) Build upon value proposition*s: Atit Diamonds' use of blockchain supports its existing strategy. Its Rock Solid Diamond Collection is positioned as conflict-free and sourced using environmentally sensitive techniques [30]. Atit participates in the Everledger network, which uses blockchain to trace diamonds from their origin to the final consumer. A distributed ledger records information about the origination, processing and transport of the diamonds. These diamonds are distributed for sale to consumers who value these ethical practices. Through the blockchain ledger, distribution partners can provide customers and industry analysts the information needed to verify that its diamonds are sourced from conflict-free zones and have been processed and transported in an environmentally sensitive manner.

2) Network reach: The size and scope of a company's network of trading partners can be an important component of strategic advantage in some companies and industries. For example, the Japanese *Keiretsu*, a network of companies with obligational relationships characterized by goodwill, allows members of the network to lower business risk and to rely on information available to the *Keiretsu.* These trusted relationships developed over long periods of time, and have allowed networks of companies, such as those associated with *Mitsubishi* and *Sumitomo* to dominate Japanese industry.

Building reliable networks is challenging, especially when there are cultural, economic and institutional differences across firms. The ability to establish trust through blockchain solutions can help networks of firms establish relationships like those that characterize *Keiretsu*, but at a faster rate.

REX homes is a blockchain-based real estate brokerage company that uses smart contracts to establish relationships [31]. It does not participate in the private multiple listing service (MLS) owned and managed by the National Association of Realtors. Instead, REX homes use a blockchain to provide free and open access to real estate listings, which encourages clients, owners and brokers to participate in the network and increases its reach [31]. Network participants also benefit. Real estate owners can provide trustworthy inspection, maintenance and utility records and potential buyers can provide validated identity and financial data on the blockchain ledger. REX's blockchain-based business model has driven explosive growth in the volume of real estate transactions closed by REX [32].

3) Access to markets: Through their participation in blockchain, firms may gain access to new customers that become aware of their offerings as a result of interactions with other members of the consortium. A company might also access new markets, for example as a result of consolidating data or sharing processes with other consortium participants.

A blockchain initiative being piloted by the Municipal Transport Company of Madrid (EMT) allows passengers to access all the city's mobility services through a central location. Previously, travellers needed to register with each transport company and purchase tickets from those companies. Using a blockchain-based app, a traveller registers once, and purchases tickets that combine train, bus, motorcycle, scooter and bicycle routes into a single ticket. Because less-used modes of transport such as bicycles and scooters show up in suggested routes, customers who typically travel only by bus or train may begin to use alternative modes, creating opportunities for alternate transport services. Thus, participation in the consortium provides access to new customers and markets for these service providers.

B. Sharing Complementary Capabilities

As with all types of strategic alliances, competitive advantage is possible when blockchain partners can accomplish more together than they can separately. Pooling participants' valuable resources and abilities enable consortium partners to develop complementary capabilities to confer an advantage on the individual partners. Blockchain solutions can promote synergistic capabilities through: 1) access to resources, 2) access to data and 3) the ability to share the risk of uncertainty. Each section includes examples from existing firms.

1) Access to resources: Companies can benefit from accessing resources through agreements with partners. A manufacturer, for example, may benefit from the advanced logistical capabilities of consortium partners, by offering greater precision and reliability in filling blanket purchase orders through dynamic routing processes. By enhancing communication, business agreements and data security, blockchain solutions allow partners to share resources safely. Partners can leverage these resources in ways that create value.

A blockchain consortium co-founded by The Port of Rotterdam, [1] designed to move beyond antiquated and fragmented record-keeping systems, allows participants to benefit [33]. Prior to this consortium, a single purchase order for a product being shipped globally can be typed over one hundred times in various siloed administrative systems. Tracking a shipment can require phone calls to several partners along the route. In the blockchain pilot, carriers allow the port access to logistics resources and information. Access to partners' shipping plans and planning algorithms can facilitate the dynamic allocation of personnel, boat docking slips, cranes, and equipment needed to move cargo. The Port can thus

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[1] This solution was developed through its Blocklab subsidiary which was co-founded by The Port of Rotterdam and the City of Rotterdam.

enhance its existing advantages in logistics and port management. Tighter coupling between shippers and ports allows more efficient resupply, loading, and crew management operations – resulting in value created for the shippers through higher levels of asset utilisation.

2) Access to data: Blockchain solutions can be used to implement data-sharing agreements among members in the shared ledger. Pooling data can provide partners with information that was previously unavailable. When combined with a partner's unique resources and capabilities, it can form the basis for new value creation, and this value may exceed the risk partners previously associated with sharing private data.

Maersk, a founder of the well-known TradeLens shipping information platform, participates in a blockchain that provides access to tailored insurance products. The industry is currently fragmented, with different insurers providing insurance for vessels, cargo, port access and other shipping elements, and reinsurers and retrocession insurers managing secondary insurance needs. Maersk has joined the Insurwave marine insurance project which uses smart contracts to streamline the insurance process [34]. Sharing vessel information through the Insurwave consortium has enabled Maersk to purchase tailored insurance products. Insurers provide products based on real-time risk data gathered by Maersk's vessels as they transport goods through various locations and weather conditions. These products, designed to meet its precise needs, enable Maersk to cost-effectively hedge against uncertainty associated with weather and other marine transport risks and to manage its trade more efficiently.

3) Share Risk among Partners: Participation in an enterprise consortium allows a firm to work with partners to share and reduce risk. Key to this is the ability of blockchain to verify information instantaneously for consortium partners as well as regulators, auditors and other parties that monitor compliance.

The Mediledger project was designed to help pharmaceutical industry participants comply with the demands of the Drug and Supply Chain Security Act, intended to ensure that pharmaceutical products sold in the US are legitimate and that trading partners are appropriately licensed and authorized [35]. Participants in Mediledger can enforce business rules and ensure compliance without exposing private data. The consortium allows partners to adapt to evolving regulations and share compliance and safety risks.

3) Strengthen collaborative relationships: Participants in blockchain consortia develop relational capital through common goals, close interaction, and reciprocity required for effective governance [36]. These relationships can improve operational performance of the partners and can provide the basis for taking advantage of mutually beneficial opportunities in the future [37].

The Pistoia Alliance, in an enterprise consortium made up of large pharmaceutical companies, participated in a use case analysis workshop to identify potential blockchain projects. The alliance has since developed the Informed Consent blockchain project which is designed to demonstrate the benefits of using blockchain-based decentralized identity methods to improve the security and consistency of processes for providing and revoking consent. The project enables patients to own and control their own personal data and to grant and revoke consent in clinical trials [38].

Participating in projects like these builds collaborative strategic relationships between these companies as they work together toward the development of common policies and processes for governing the shared blockchain solution. Subsequent to their informed consent collaboration, partners jointly sponsored a blockchain hackathon to identify solutions to communicable disease. The Pistoia Alliance has launched a seed fund through which they make joint investments in promising projects [39].

C. Building New Capabilities Around Blockchain Technologies

Companies participating in blockchain consortia can build new capabilities around a blockchain competency. These meet the definition of capabilities as organisationally embedded, non-transferable firm-specific resources. We suggest that these blockchain capabilities are the most overlooked potential sources of competitive advantage when firms focus on the operational improvements delivered by blockchain. Firms may use these new capabilities as the foundation for development of strategic capabilities and then position the company to participate in additional strategic alliances more easily, including blockchain consortia. We illustrate how new capabilities can be built around: 1) specific tools such as smart contracts or 2) around general capabilities around blockchain implementation or blockchain management.

1) Smart contract expertise: Smart contracts are programs, run on the blockchain, that implements policies and contract obligations in software. They can execute, control and archive events as specified in legal contracts or agreements. These programs can respond in close to real time to triggering events. Smart contracts can be as simple or as complex as the agreements between contracting parties. As companies become more experienced in developing smart contracts, they can manage increasingly complex and idiosyncratic agreements effectively. Further, knowing that such agreements can be codified may enable new agreements that could only be executed through smart contracts.

Developing expertise in smart contracts can minimize the risks of contract failures due to security vulnerabilities and coding errors [40]. Ricardian contracts, which create machine-readable equivalents to prose contracts, can help alleviate some contracting problems [41]. Companies that develop the technological resources to effectively design secure and accurate contracts can extract greater value.

GrainChain uses smart contracts to manage payments and transfer of goods between farmers, trucking companies, grain silos, grain purchasers and banks [42]. Where contracts once had to be manually calculated and adjusted according to the amount and nature of grain delivered, this process is automated through smart contracts. When a truckload of grain is received at a silo, it is weighed and classified on a variety of quality and chemical attributes. Smart contracts use test results to price delivery according to previously executed agreements between the farmer and purchaser. Once the delivery and its characteristics are recorded, payment can be issued immediately to the farmer—a vast improvement from a process that could take weeks and was error-prone.

2) Consortium-related managerial expertise: Participating in blockchain consortia requires companies to participate in blockchain governance, which determines the rules and procedures participants must follow when interacting with the blockchain. Through this process, firms learn how to become effective consortium participants. Firms also gain experience forming relationships across the network, which is significant because blockchain allows for linkages with new partners as the network grows. To capture value, participants must learn how to manage and prioritize these linkages.

Experience with one blockchain solution can be used to more effectively identify use cases that will result in value creation and capture and seek out or build solutions for these use cases. The consortium-related capabilities a company develops through participation in one consortium can carry over to these new solutions. Furthermore, an experienced company can evaluate the implications of a blockchain's functions, governance mechanisms and the effects on the company as well as its strategic relationships over time.

Henkel, a large consumer goods company, has taken an active learning approach to the development of blockchain-related capabilities [43]. The blockchain innovation team uses "discovery workshops" to identify and evaluate potential use cases throughout the company and its institutional capability in blockchain is growing steadily. The company also participates in the development of standards and certifications that build greater confidence in, and accelerate the adoption of blockchain solutions. It also participates in trade organisations and events that enhance learning and foster cross-industry cooperation.

Henkel's pilot blockchain project focused on more effective tracking and exchange of transport pallets. The company has since participated in a variety of unrelated blockchain consortia including PlasticBank, a social enterprise that recycles ocean plastic, and TaxChain, which captures value-added taxes (VATs) through cross-border supply chains. Henkel has developed deep consortium-related blockchain expertise and now has "one of the most diverse blockchain portfolios in the enterprise space" [43].

3) Blockchain relational capabilities: Blockchain expertise can be developed by individual firms, but collaborators in blockchain projects can develop blockchain-related relational capital that provides the foundation for future blockchain collaborations that draw upon and build capital around relationships that enables value-capture for collaborators through joint blockchain projects.

PharmaLedger, a consortium of pharmaceutical companies and public and private entities engaged in healthcare solutions. The 29 participants worked collaboratively to develop a platform to support the design and development of blockchain solutions that would support innovation across the ecosystem. Consortium partners have formed and strengthened relationships that enable the creation of value through blockchain collaborations. Through this effort, the group has developed ethical and legal frameworks and an industry digitisation strategy, and a marketplace for health data. [44] These artifacts are the tangible products of the relational capital developed through collaboration and have paved the way for the consortium to develop eight healthcare-related use cases in its three-year tenure. [45]

6. Conclusion

Despite its promise, blockchain has not yet achieved its potential. While the operational benefits of blockchain adoption are widely recognized, strategic benefits are not well understood, even among technical and strategic leaders involved in their implementation. We present memberships in blockchain consortia as forms of strategic alliances and use RBV to motivate the introduction of strategic alliances as a tool to access resources that can be the basis of competitive advantage. We illustrate how strategic value can be created through three avenues. The first is by joining alliances and building relationships that enhance and contribute to existing capabilities. The second by sharing and building complementary capabilities with partners through access to resources and data as well as sharing risk among partners. The third by building blockchain capabilities through gaining smart contract expertise developing more managerial expertise around implementing blockchain solutions. The domain of strategic opportunities by blockchain allows firms and consortia to create value through multiple sources. Figure 1 summarizes the contributions of this paper in explicating these opportunities.

Embedded in the RBV is the concept of capabilities as sources of competitive advantage that are built over time and difficult to imitate or substitute. This implies first-mover advantage potential, even as blockchain is still nascent. Firms that aggressively build these capabilities can not only be part of the conversation but also have the potential to shape the conversation around implementation of blockchain consortia. Dale Chrystie, FedEx's blockchain strategist, refers to the urgency of developing capabilities as "not yet, but don't be late for the game" [46]. Firms deciding not to invest in blockchain face the risk of being locked

DOMAIN	VALUE CATEGORY	SOURCES OF VALUE
Operational problems	Lack of trust	Provenance and immutability Privacy and security
	Friction in workflows	Smart contracts and value transfer Cost reduction and disintermediation
Strategic opportunities	Build upon existing capabilities	Strengthen value proposition Expand network reach Access new markets
	Share complementary capabilities	Leverage partners' resources Gain access to data Share risk among partners Strengthen collaborative relationships
	Develop blockchain-specific capabilities	Smart contract expertise Consortium and use case expertise Blockchain relationships and collaborations

Figure 1: Blockchain Strategic Opportunities and Unexplored Sources of Value

out of the new competitive landscape as industries will be fundamentally disrupted and changed.

As blockchain solutions are adopted, assumptions about firm boundaries will be challenged. Many theories in strategic management, including RBV, are rooted in economic theories that focus on firm-level behaviour and performance. Adoption of a stakeholder perspective, in contrast, necessitates conceptualising performance beyond the firm level [15]. The adoption of blockchain can lead to shrinking or expanding firm boundaries [6]. As we focus more broadly on ecosystems, questions about transactions being "within" or "outside" a firm's boundary are less important than questions about how bundles of exchanges can generate social and economic wealth [47]. A Transaction Cost Economics view of blockchain may be helpful for future scholarly work.

Effective deployment of enterprise blockchain solutions can facilitate the development of trust, cooperation and risk-sharing among firms that otherwise may only consider each other as competitors. This allows firms to think beyond a binary view of competition and cooperation and embrace "coopetition" [48], [49], [50]. Blockchain encourages the kind of openness and collaboration associated with trade or standards organisations or with open-source software development projects in which long-term collaboration among partners is more typical.

As blockchain solutions become ubiquitous, traditional relationships, business models and entire industries will be disrupted. We agree with the World Economic Forum [51] that blockchain has the potential to revolutionize how companies compete and collaborate, and that strategic value can be captured by companies that begin the process of building strategic capabilities through blockchain.

Your organization or industry cannot sit on the sidelines for 3-5 years waiting for the technology to mature. If the blockchain solutions are relevant to your business, you should start preparing a non-technical and technical foundation progressively for the eventual mainstream operations. [51, p. 8]

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